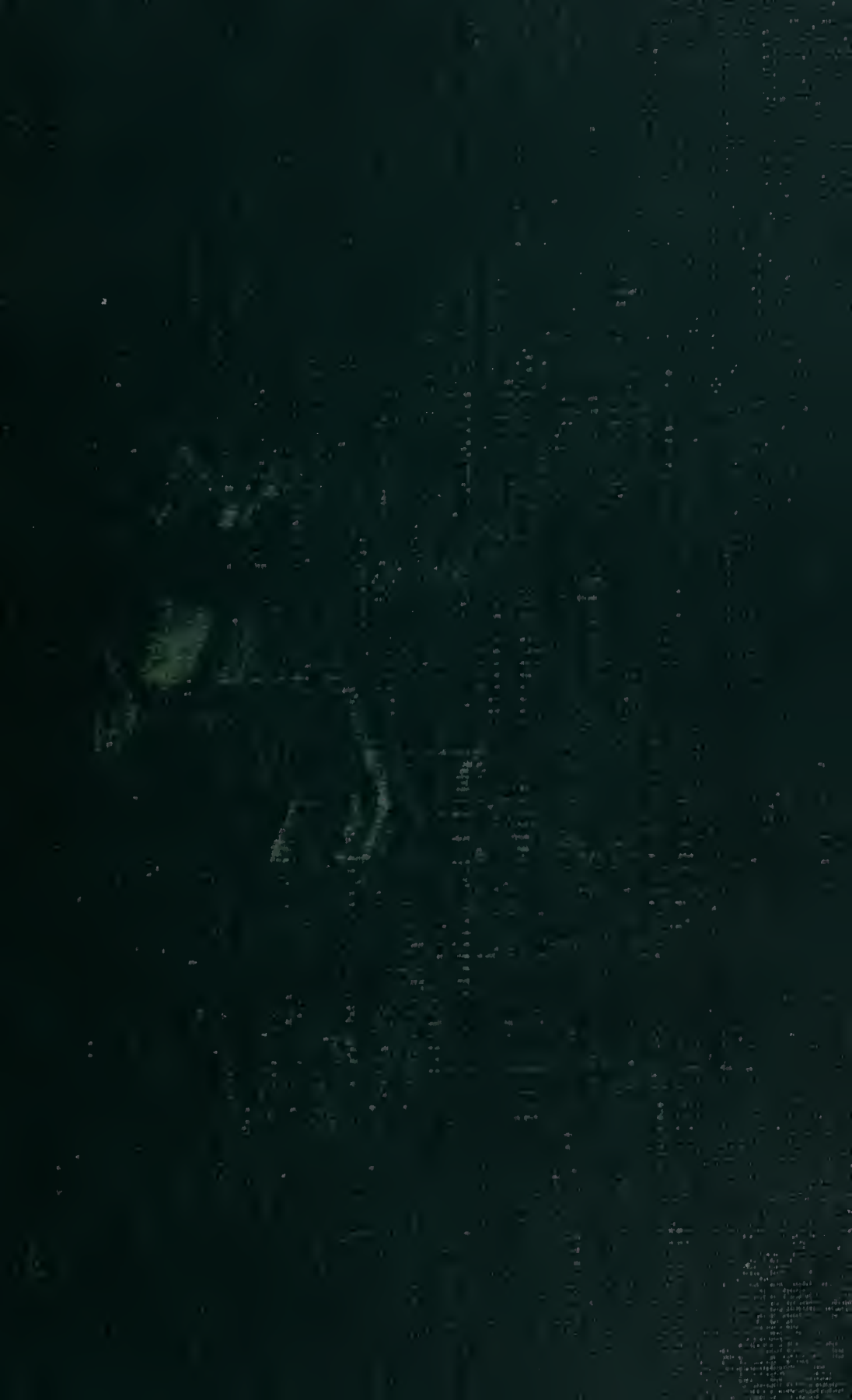

STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION
DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief*

REPORT OF INVESTIGATIONS—NO. 19

I—PHYSIOGRAPHIC DIVISIONS OF THE AREA COVERED BY THE ILLINOIAN DRIFT-SHEET IN SOUTHERN ILLINOIS

II—RECENT DISCOVERIES OF PRE-ILLINOIAN DRIFT IN SOUTHERN ILLINOIS

By PAUL MacCLINTOCK

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

URBANA, ILLINOIS
1929

STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION

M. F. Walsh, *Director*

BOARD OF

NATURAL RESOURCES AND CONSERVATION

M. F. Walsh, *Chairman*

Edson S. Bastin, *Geology*
William A. Noyes, *Chemistry*
John W. Alvord, *Engineering*
William Trelease, *Biology*
Henry C. Cowles, *Botany*
Charles M. Thompson, *Representing the President of the University of Illinois*

STATE GEOLOGICAL SURVEY DIVISION

M. M. Leighton, *Chief*

Jeffersons Printing & Stationery Co.
Springfield, Illinois
1929

Letter of Transmittal

State Geological Survey Division, July 8, 1929.

Hon. M. F. Walsh, Chairman, and Members of the Board of Natural Resources and Conservation,

Gentlemen: I take pleasure in transmitting herewith for publication as Report of Investigations No. 19 the manuscripts for the papers entitled *"Physiographic divisions of the area covered by the Illinoian drift-sheet in southern Illinois"* and *"Recent discoveries of pre-Illinoian drift in southern Illinois,"* both by Dr. Paul MacClintock, who is making a study of the Pleistocene and Recent history of the glaciated portion of southern Illinois.

This study has progressed far enough that from the scientific and educational standpoints it is believed that these papers will be of particular interest to teachers in our public schools, research workers in geology, and to water well engineers in their search for underground water supplies.

Very respectfully yours,

M. M. Leighton, *Chief.*

Contents

I. PHYSIOGRAPHIC DIVISIONS OF THE AREA COVERED BY THE ILLINOIAN DRIFT-SHEET IN SOUTHERN ILLINOIS

OUTLINE

FIGURES

PHYSIOGRAPHIC DIVISIONS OF THE AREA COVERED BY THE ILLINOIAN DRIFT-SHEET IN SOUTHERN ILLINOIS

By Paul MacClintock

INTRODUCTION

The topography of that part of southern Illinois[1] covered by the Illinoian till-sheet is of unsual interest to the student of land forms. Physiographically, the area lies within the Till-plains section of the great Central Lowland Province.[2] The first impression is of monotonous flatness, holding no problems for the physiographer, but closer study discloses subtle differences in the topography whose interpretation calls forth fundamental principles of geomorphology.

The area consists partly of a plain and partly of gently rolling hills, 50 to 60 feet high, though a few are as much as 100 to 125 feet in height. As the whole area is mantled with drift, and much of it with loess as well, outcrops of bedrock are rare and, where found, are commonly so low in valley walls that they do not help much in deciphering the origin of the upland topography. Furthermore, where morainic topography formerly existed, Sangamon erosion so far subdued it that its identification as such becomes very difficult.

As a result of the present study, the Illinoian drift area south of Sangamon and Illinois rivers and the Shelbyville moraine has been found to embrace nine distinct physiographic subdivisions. Sand dune topography might be included as a tenth subdivision, but its extent in the area is too limited to be important areally. Obviously there are all gradations between the subdivisions, rendering the boundaries indistinct; but within the area or areas of each subdivision the topography has its characteristic features. The principle areas are shown in figure 1.

The analysis is made on the basis of *destructional topography*, that produced by running water erosion, and *constructional topography*, that produced by glacial deposition. The interpretation is made possible by the fact that post-Paleozoic pre-Pleistocene erosion of the nearly horizontally stratified Coal Measures progressed to the state of maturity, in parts late maturity, during the last Tertiary cycle. Deposition of the mantle of drift is con-

[1] South of the Sangamon-Illinois Rivers and the Shelbyville moraine.

[2] Fenneman, N. M., Physiographic divisions of the United States: Annals of the Association of American Geographers, vol. 6, pp. 19-98, 1916.

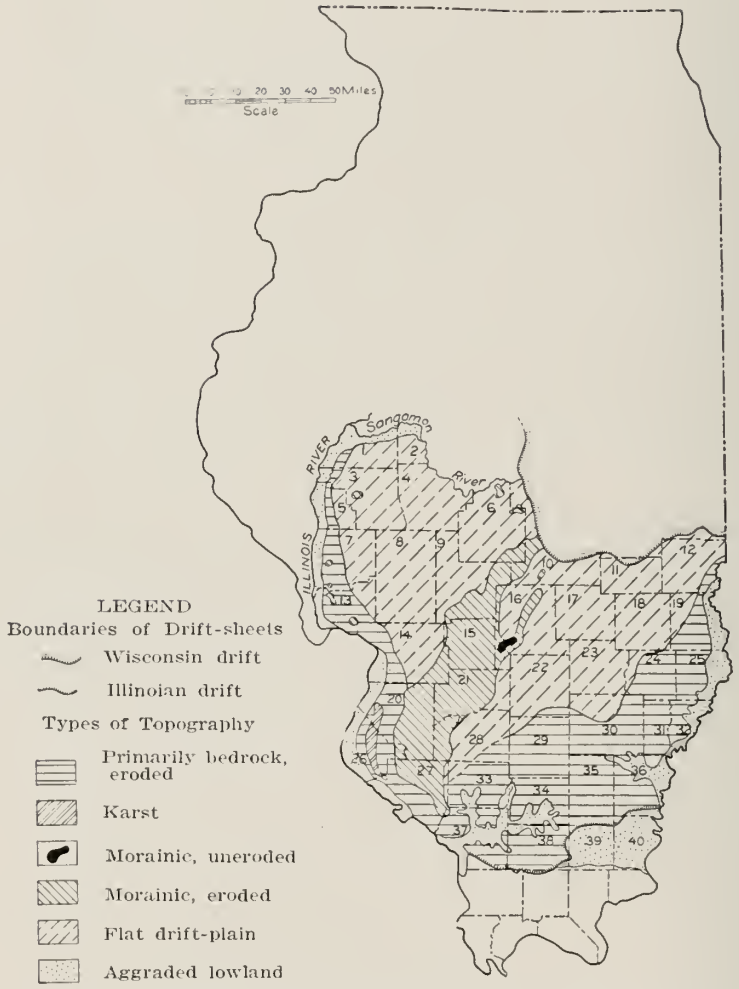

Fig. 1. Outline map showing distribution of the topographic subdivisions in the area covered by the Illinoian drift-sheet, in southern Illinois.

INDEX TO COUNTIES

1. Cass	11. Cumberland	21. Clinton	31. Edwards
2. Menard	12. Clark	22. Marion	32. Wabash
3. Morgan	13. Jersey	23. Clay	33. Perry
4. Sangamon	14. Madison	24. Richland	34. Franklin
5. Scott	15. Bond	25. Lawrence	35. Hamilton
6. Christian	16. Fayette	26. Monroe	36. White
7. Greene	17. Effingham	27. Randolph	37. Jackson
8. Macoupin	18. Jasper	28. Washington	38. Williamson
9. Montgomery	19. Crawford	29. Jefferson	39. Saline
10. Shelby	20. St. Clair	30. Wayne	40. Gallatin

sidered the beginning of a new cycle in the topographic history of the region and post-Illinoian erosion has advanced only to youth in the present cycle. The contrast between the wide valleys with gently sloping walls of the bed-

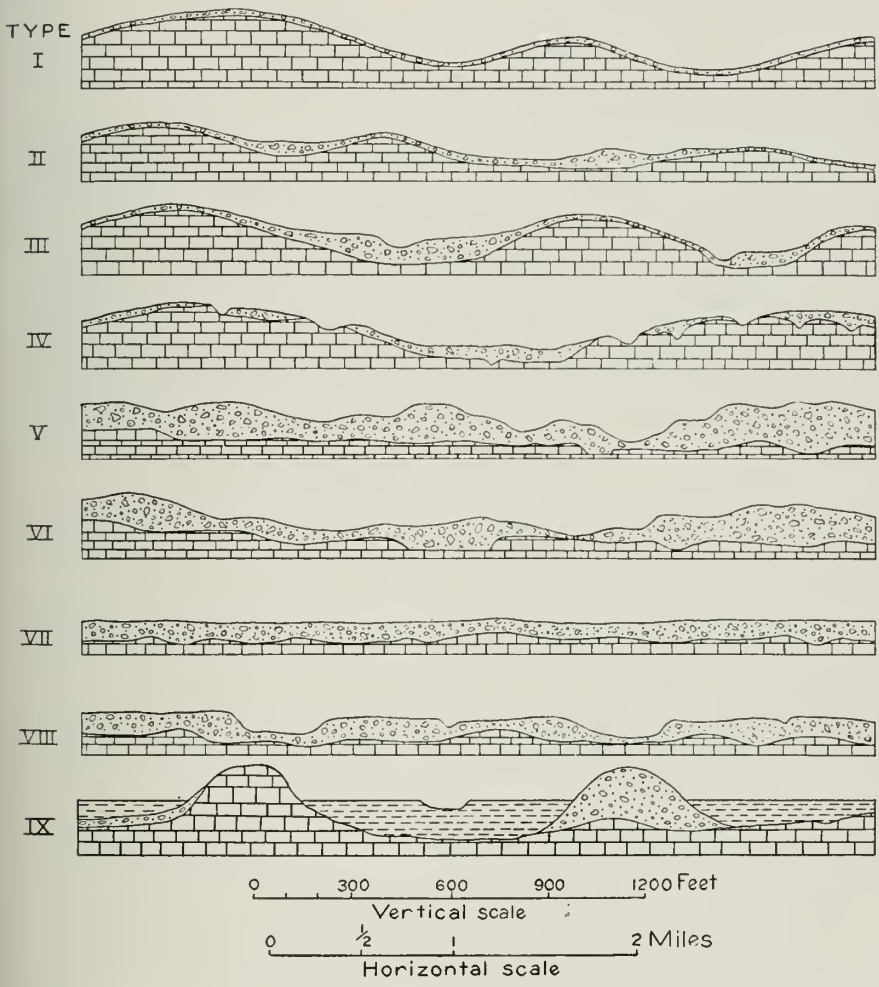

Fig. 2. Diagrammatic cross-sections showing the relationships between bedrock and glacial drift for the nine types of topography described.

rock topography and the steep-sided post-Illinoian valleys is not hard to see, but the distinction between broad valleys controlled by bedrock and broad depressions in undulatory constructional topography may be easily overlooked.

PHYSIOGRAPHIC SUBDIVISIONS AND THE CRITERIA FOR DIFFERENTIATING THEM

The following are the physiographic subdivisions which are found and the criteria by which they are recognized. Diagrammatic cross-sections illustrating the relationships between bedrock and glacial drift for each of the physiographic types are shown in figure 2.

I. TOPOGRAPHY CONTROLLED PRIMARILY BY BEDROCK; DRIFT TOO THIN TO AFFECT IT

(Figures 3 and 4)

Characteristic features:

(a) Surface gently rolling
(b) Surface all in slopes
(c) Dendritic type of valley development
(d) Wide open valleys
(e) Gently sloping valley-walls
(f) Structural terraces
(g) Rounded divides
(h) Divides unequal in height

Fig. 3. Topography controlled by bedrock, northwest part of Saline County. Type I.

Fig. 4. Topography controlled by bedrock, two miles west of Macedonia, Hamilton County. Type I.

II. TOPOGRAPHY CONTROLLED BY BEDROCK MODIFIED BY SLIGHTLY ERODED DRIFT

(Figures 5 and 6)

Characteristic features:

(a) Surface gently rolling
(b) Surface mostly in slope, but some flattish areas in lower parts
(c) Dendritic type of valley development; here and there a rise or a depression does not fit into a perfect dendritic system
(d) Wide open valleys predominate, but some are constricted
(e) Gently sloping valley-walls
(f) Rounded divides
(g) Divides unequal in height

Fig. 5. Topography controlled by bedrock, considerably modified by slightly eroded drift, in eastern Marion County. The hill in the background is of bedrock. Type II.

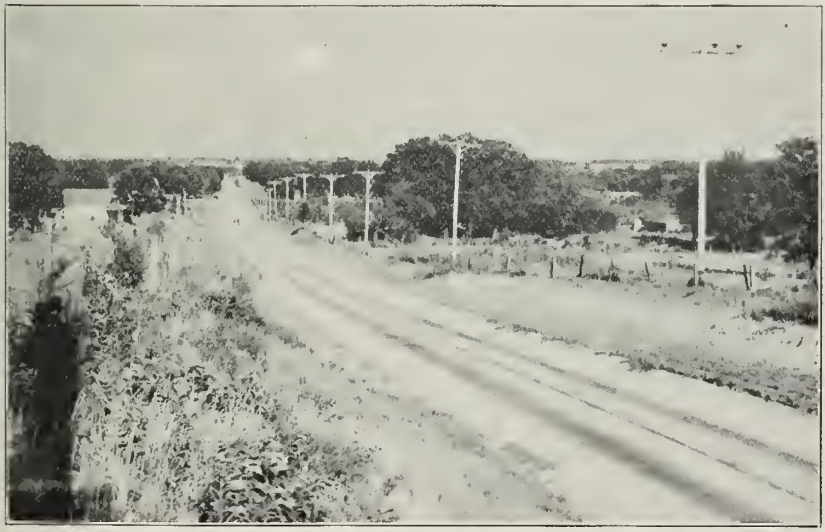

Fig. 6. Topography controlled by bedrock, slightly modified by drift, seven miles west of Mount Vernon, Jefferson County. Type II.

III. TOPOGRAPHY CONTROLLED BY BEDROCK MODIFIED BY ERODED DRIFT

(Figures 7 and 8)

Characteristic features:

(a) Surface gently rolling
(b) Surface mostly in slopes
(c) Type of valley development in general dendritic
(d) Wide open valleys, with steeper valleys within them in middle or against one side
(e) Upper part of valley-walls gently sloping, inner or lower part steeper
(f) Divides unequal in height

IV. KARST TOPOGRAPHY MODIFIED BY DRIFT AND LOESS (SPECIAL PHASE OF BEDROCK CONTROL)

Characteristic features:

(a) Lakes
(b) Undrained depressions, relatively small and deep
(c) Depressions haphazard in topographic position
(d) Major drainage development of dendritic type

Fig. 7. Topography controlled by bedrock, modified by eroded drift, one mile south of Akin, Franklin County. Type III.

Fig. 8. Topography controlled by bedrock, modified by eroded drift, seven miles west of Mount Vernon, Jefferson County. Type III.

V. TOPOGRAPHY CONTROLLED BY MORAINIC DRIFT, UNERODED

(CONSTRUCTIONAL TOPOGRAPHY; Figure 9)

Characteristic features:

(a) Surface, rolling to hilly
(b) Non-dendritic type of drainage
(c) Undrained depressions
(d) Bottoms of depressions unequal in altitude
(e) Steepness of slope independent of drainage or of topographic position

VI. TOPOGRAPHY CONTROLLED BY MORAINIC DRIFT, ERODED

(Figure 10)

Characteristic features:

(a) Surface, rolling to hilly
(b) Major features, depressions and hills, haphazard in topographic position
(c) Minor drainage features, as gullies, dendritic
(d) No undrained depressions
(e) Bottoms of depressions unequal in altitude
(f) Depressions largely graded to external drainage
(g) Steepness of slope somewhat independent of drainage and of topographic position

Fig 9. Lake basin (recently drained artificially) in uneroded morainic topography, five and a half miles southwest of Vandalia, Fayette County. Type V.

Fig. 10. Morainic topography, but little eroded, three miles west of Vandalia, Fayette County. Type VI.

VII. TOPOGRAPHY CONTROLLED BY DRIFT, NON-MORAINIC, FLAT, UNERODED

(Figures 11 and 12)

Characteristic features:

(a) Flat
(b) Above grade of nearest stream

Fig. 11. Flat-divide topography in western Cumberland County. Type VII.

Fig. 12. Illinoian flat, south from the Shelbyville moraine, Clark County. Type VII.

VIII. TOPOGRAPHY CONTROLLED BY DRIFT, NON-MORAINIC, ERODED

(TABULAR-DIVIDE TOPOGRAPHY; Figures 13 and 14)

Characteristic features:

(a) Flat divides
(b) Divides practically equal in altitude
(c) Dendritic drainage pattern
(d) Steep-sided valleys

IX. AGGRADED-LOWLAND TOPOGRAPHY; HILLS EITHER BEDROCK OR DRIFT

(Figure 15)

Characteristic features:

(a) Isolated hills rising above lowlands
(b) Very broad, flat lowlands
(c) Lowlands all at grade
(d) Sharp angle at base of hills

Fig. 13. Tabular-divide topography, two miles north of Oconee, Shelby County. Type VIII.

Fig. 14. Tabular-divide topography in Clark County. Type VIII.

Fig. 15. Aggraded lowland topography. Gold Hills rise in the distance from the Saline flat, Gallatin County. Type IX.

It is not possible on a map of the scale of figure 1 to differentiate between the topography controlled by bedrock and that primarily controlled by bedrock but modified by drift, although a single landscape, if viewed with the foregoing criteria in mind, may easily be classified into one of these types. That area mapped as controlled by bedrock includes therefore not only the bedrock topography modified by drift, eroded and uneroded, but also a few small areas where drift locally controls the topography. Likewise, within the area of flat drift, the eroded and uneroded types are mapped together.

HISTORICAL INTERPRETATION

Introduction

Prior to the invasion of the Pleistocene ice-sheets, stream erosion of the bedrock had blocked out the major topographic features of the region. Practically flat-lying sandstones and shales of the Coal Measures were eroded by a normal dendritic type of drainage into gently rolling country. There are, however, many isolated hills of bedrock, composed of rather well cemented sandstone, which rise 50 to 100 feet above the general level of the surrounding uplands. This suggests that the region may have passed through two cycles of erosion; the former having advanced to old age or even peneplanation, with these isolated hills standing as monadnocks above a broad flattish surface; and the latter, after rejuvenation, having progressed to maturity. Such a history cannot be determined definitely for an area of horizontally stratified rocks of unequal resistance, but evidence from adjacent regions confirms the suggestion. The peneplain is considered to be late Tertiary in age, an age postulated by correlation with the Tertiary gravels in the extreme southern part of the State, and by correlation with physiographic features and history in adjacent areas. The rejuvenation and erosion of the peneplain to the present bedrock topography evidently was accomplished in late Tertiary or earliest Quaternary time, for the earliest ice-sheet of the Pleistocene spread over a bedrock topography of the same relief as that of the rock topography in the area today, evidenced by Nebraskan drift which is found down in the bedrock valleys. It was upon this bedrock foundation that the ice-sheets deposited drift in such varying manner as to produce the topographic types described.

I. Topography Controlled by Bedrock (pp. 10-11)

In the area described as controlled by bedrock, the Illinoian drift is so thin that it is represented either by a foot or two of till only or by merely erratic stones seen between the bedrock and the overlying loess. The drift is so thin that its effect on the topography is negligible.

II. Topography Controlled by Bedrock Modified by Slightly Eroded Drift (pp. 12-13)

The second type of topography is seen where the Illinoian ice-sheet deposited drift in sufficient thickness in the valleys to modify noticeably the topography. Small constructional features can be recognized in the general erosional landscape.

III. Topography Controlled by Bedrock Modified by Eroded Drift (pp. 14-15)

In many places stream erosion in post-Illinoian time has cut into the drift which modifies the bedrock topography, and has developed a third type of topography controlled primarily by bedrock.

IV. Karst Topography Modified by Drift and Loess

The karst type of topography was produced by solution of the limestone to form limestone sinks. Its original relief has been subdued by deposition of till and loess.

V. Topography Controlled by Morainic Drift, Uneroded (pp. 16-17)

An area of constructional topography six miles long and three miles wide occurs in southwestern Fayette County, starting three miles southwest of Vandalia. It was produced by extremely irregular deposition of material at the edge of the melting ice and still shows numerous undrained depressions. Several of these depressions contain small lakes at present, and others did so until they were artificially drained a few years ago. Numerous other lowland tracts exhibit the flat floor of a lake destroyed by aggradation. In addition, the area presents the kame-and-kettle features of strong terminal morainic topography, comparatively little modified by gradation by running water. Surface weathering of the drift to the characteristic soil profiles, including gumbotil on the flatter tracts, dates the drift as Illinoian in age. It is remarkable that this topography should have persisted since its formation in Illinoian time. Roadside exposures and well records show the material to be largely sand and gravel, and it may be that the porosity of the drift has been a factor in retarding surface erosion in this area.

VI. Topography Controlled by Morainic Drift, Eroded (pp. 16-17)

The great belt of morainic topography passing across the central part of southern Illinois from northeast to southwest, called by Leverett the Ridged Drift of the Kaskaskia Basin,[3] constitutes the sixth type of topog-

[3] Leverett, Frank, The Illinois glacial lobe: U. S. Geol. Survey, Mon. 38, p. 71, 1899.

raphy, that controlled by morainic drift, eroded. Considerable outwash material on the west side of many of the ridges, and in several places—particularly in Fayette County—well developed outwash-plains extending westward from masses of drift, indicate that Leverett's third hypothesis is probably correct; namely, "that the ridges mark the western border of the lobe after the ice had retreated from western Illinois."[4] The area was once typically morainic, but post-Illinoian, largely pre-Peorian, erosion has subdued the original topography of this belt until only in the area described above (type V) are undrained depressions and other fresh morainic features preserved.

VII and VIII. Topography Controlled by Non-Morainic Drift, Uneroded and Eroded (pp. 18-21)

The seventh and eighth types are considered together because they were originally the same, but streams have cut into the former flat surface, leaving areas of tabular-divide country. The extreme flatness of the original surface of the till sheet is very striking; one may cross it, mile after mile, without seeing a hill or a depression as much as ten feet in relief. Three hypotheses present themselves to account for this remarkable flatness.

(1) It may well have been that the Illinoian ice-sheet melted so uniformly and continuously that features produced by irregular deposition of drift along a halting ice-edge were never formed.

(2) A second suggestion is that the supply of snowfall so diminished that the glacier ceased to move and simply melted off the whole area at one time. If the climate became arid, evaporation played a significant part. The virtual absence of outwash material on the surface of the drift in the area of this type of topography may be cited in support of this suggestion. To produce such flatness in this way, the ice must have contained a uniformly distributed load, which seems probable in this instance where the ice had come for a long distance over rather flat country underlain largely by Coal Measures rocks. If the bedrock topography were practically flat, the foregoing suggestion might account for the flatness of the till-sheet, but well records and bedrock exposures in valleys show that the rock topography has a considerable relief, as much, in fact, as in the areas of topography controlled by bedrock.[5] It is evident, then, that drift was deposited more thickly in the low places and more thinly over the hills, but it seems unlikely that this would produce the flatness noted.

(3) The third suggestion arises from the discovery of many exposures of pre-Illinoian drift within the area of flat and tabular-divide topography. As no pre-Illinoian drift has been found outside the area of topography controlled by drift, it seems plausible that the older drift so filled the depres-

[4] Leverett, Frank, op. cit., p. 75.

[5] Lee, Wallace, U. S. Geol. Survey Geol. Atlas Gillespie-Mount Olive Folio (No. 220), figs. 12 and 14, 1926.

sions in the bedrock topography that the Illinoian ice-sheet, traversing a country already partly flattened, could produce the monotonously flat plain under discussion. An example of this grading up of a region by pre-Illinoian drift is seen in the valley of Big Creek in Clark County, three and a half miles north of Marshall (fig. 16). Here the top of the pre-Illinoian drift is at about the same level as the tops of the bedrock hills, and both are buried to about the same depth by Illinoian till.

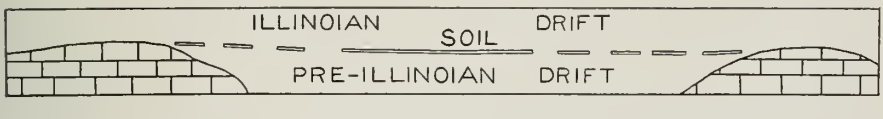

Fig. 16. Diagrammatic cross-section showing pre-Illinoian drift filling a depression in bedrock and overlain by Illinoian drift (according to data obtained along Big Creek, Clark County).

IX. AGGRADED-LOWLAND TOPOGRAPHY (pp. 20-21)

Post-Illinoian pre-Wisconsin erosion deepened and widened the valleys of Mississippi and Wabash rivers and many of their tributaries, such as Big Muddy, Embarrass, Bonpass, and Little Wabash rivers. Sediment-laden waters from the Wisconsin ice-sheets aggraded the lowlands along the main streams with outwash deposits, which in turn checked and ponded the tributary drainage, producing together the extensive aggraded lowland flats of the ninth type of topography.

II. RECENT DISCOVERIES OF PRE-ILLINOIAN DRIFT IN SOUTHERN ILLINOIS

OUTLINE

FIGURES

RECENT DISCOVERIES OF PRE-ILLINOIAN DRIFT IN SOUTHERN ILLINOIS

By Paul MacClintock

INTRODUCTION

In the course of three seasons' study of Pleistocene deposits of southern Illinois many exposures of pre-Illinoian drift have been discovered (fig. 1). These deposits are sufficiently scattered to show that an ice-sheet older than the Illinoian invaded and covered a large part of southern Illinois, although only where Illinoian drift rests directly on older drift is the evidence conclusive that there are two drift sheets. In general the presence of two drifts is recognized by evidence that the lower one suffered prolonged weathering prior to the deposition of the upper one. The Illinoian ice eroded the upper portion of the lower soil and till to various depths. In one place there was no erosion whatever and the vegetation growing in the old soil has been preserved; in several other places the surface soil has been removed, leaving the subsoil horizon intact; in other places both the soil and the subsoil were stripped away, but leached and oxidized drift was left below the fresh Illinoian till; and in still other places the soil zones as well as the leached part of the lower drift were removed, leaving only the oxidized part of the lower till below unoxidized Illinoian till. Where the oxidized portion of the lower drift has been removed also, the presence of two tills cannot easily be proved. Probably there are many such unidentified occurrences.

The area under consideration is bounded on the north by Sangamon River and Shelbyville moraine (early Wisconsin age) and on the south by the border of the Illinoian till-sheet. The exposures described are discussed in order of counties from east to west.

For the convenience of the reader the following classification of Pleistocene time is inserted:

Glacial and interglacial epochs of the Pleistocene period

Era	Period	Epoch
Cenozoic	Quarternary	Recent
		Wisconsin glacial
		Peorian interglacial
		Iowan glacial
		Sangamon interglacial
	Pleistocene	Illinoian glacial
		Yarmouth interglacial
		Kansan glacial
		Aftonian interglacial
		Nebraskan glacial

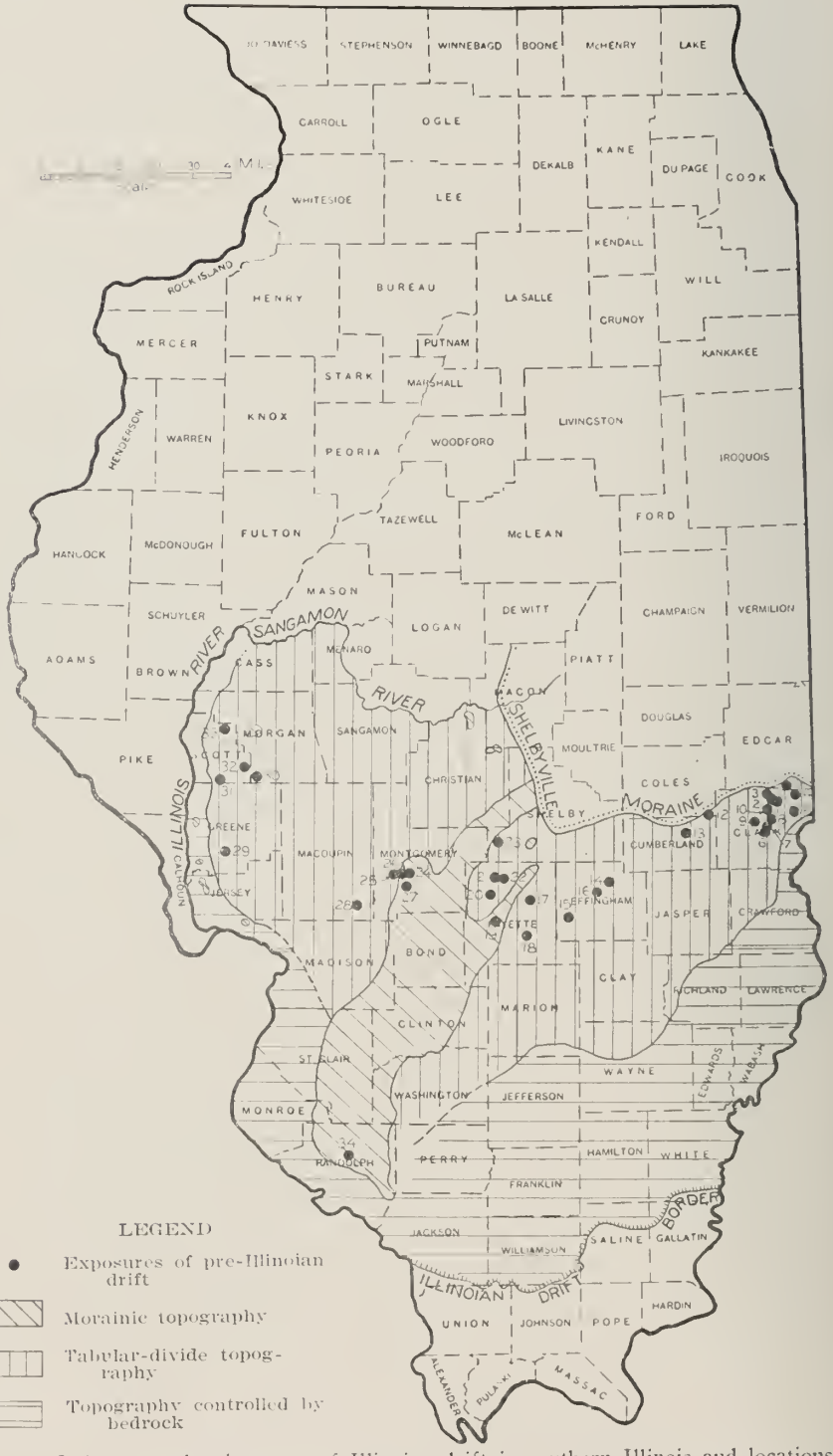

Fig. 1. Index map showing area of Illinoian drift in southern Illinois and locations of exposures of pre-Illinoian drift, numbered for text reference.

DESCRIPTIONS OF EXPOSURES

CLARK COUNTY

Clark County lies along the eastern boundary of the State about midway in its north-south extent. It is the most northerly and eastern county of the exceedingly flat, tabular, Illinoian till-plain. The Shelbyville moraine, of early Wisconsin age, lies only three to four miles north of the county (figs. 1 and 2) and swings southward across its northwest corner. This moraine rises a hundred feet or more above the plain to form one of the conspicuous topographic features of the region. Otherwise its monotonous flatness is broken only by, (1) a very gentle north-south swell upon which Marshall is located, (2) the swell in the western part of the County, upon which Casey and Oilfield are located, and (3) the steep-sided valleys cut 50 to 100 feet below the upland plain. The valleys lead southeastward to the Wabash valley, with which they are at grade.

In a number of these deep valleys the streams have undercut the valley walls, showing many exposures of drift and bedrock which provide the data for this study. The drift is so poor an aquifer and the bedrock water is so scanty and impure that the water wells are all shallow and their records are unimportant; likewise the numerous oil wells within the county are of little value in studying the drift because no accurate records have been kept of this surficial material. Among the river-bluff exposures ten localities were found in Clark county where undoubted pre-Illinoian drift lies below Illinoian. These are sufficiently significant to be described in detail.

Big Creek exposure of interglacial soil.—A remarkably complete interglacial soil, with even the grass of the old turf preserved, is found in an exposure on the west side of Big Creek three and a half miles north-northwest of Marshall (fig. 2, location 1). Drift forms a steep bluff 60 feet high and more than 600 feet long. At the time of the visit in 1926 there had been enough slumping to conceal the lower part of the section in the middle and at the north end of the exposure, but at the south end drift was seen *in situ* down to the river-level. At many other places along this same valley the top of the bedrock lies 15 to 20 feet above the river-level, showing that the bedrock had considerable relief before deposition of the drift and that this particular deposit occupies one of the lower places in the pre-glacial topography. So steep was the bank that it was necessary to cut steps in the drift in order to climb up to examine it in detail. It was obvious that slumping could not have altered the relations or distribution of the materials exposed. The geologic section was as follows:

Glacial and interglacial deposits along Big Creek
(South Center NW. ¼ sec. 2, T. 11 N., R. 12 W.)

		Thickness Feet	Inches
Illinoian			
12.	Till, leached	7	
11.	Till, calcareous, oxidized, dark buff	18	
10.	Till, calcareous, dense, blue-gray, silty; with coniferous wood and gastropod shells in lower part	25	
Pre-Illinoian			
Interglacial			
9.	Moss or grass		½
8.	Soil, calcareous, fossiliferous		2
7.	Silt, light, powdery, fluffy, reddish-brown; horizontal fracture-tendency; leached	1	
6.	Silt, dense, compact, leached; conchoidal fracture, vertical columnar tendency; few scattered siliceous pebbles	3	6
5.	Gumbotil, bluish-gray in places and brownish in others	2	
4.	Sub-gumbotil, iron-stained and in places iron-cemented, 1 foot to	1	6
Glacial			
3.	Till, calcareous, drab-brown, dense, hard	4	
2.	Till, calcareous, blue-gray, dense	18	
1.	Slump	10	
	Total height of exposure	90+	

Fossils from the interglacial soil, identified by Mr. F. C. Baker, Curator of the Museum of Natural History, University of Illinois, are as follows:

Fossils from a pre-Illinoian soil along Big Creek

1. Polygyra sp. Crushed
2. Polygyra monodon (Rackett)
3. Hendersonia occulta (Say)
4. Succinea ovalis (Say)
5. Helicodiscus paralellus (Say)
6. Cochlicopa lubrica (Mull.)
7. Vertigo ventricosa (Morse)
8. Vertigo ovata (Say)
9. Carychium exile (H. C. Lea)
10. Carychium exile canadensis (Clapp)
11. Galba parva (Lea)
12. Gyraulus parvus (Say)

The first ten are shells of land snails but the last two belong to types that live in wet places such as the edges of ponds or rivers.

The pebble-count from the fresh lower till shows 54 per cent of limestone and only 7 per cent of chert, whereas the pebbles in the fresh Illinoian

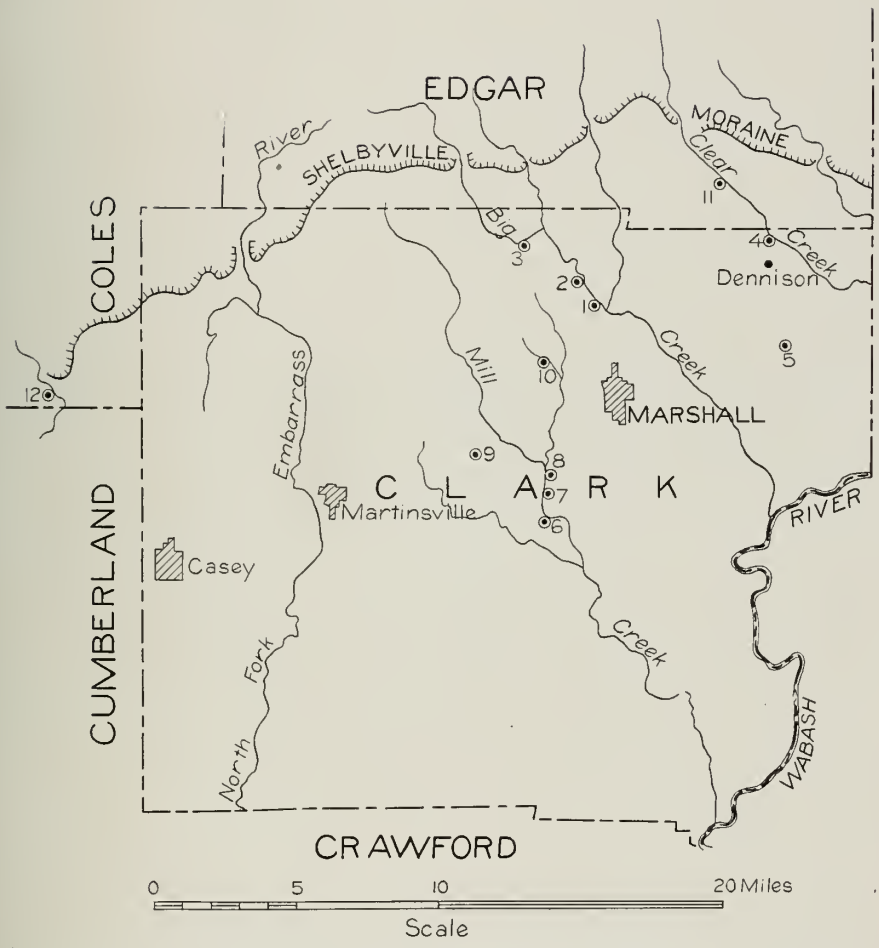

Fig. 2. Index map of Clark County showing locations of exposures of pre-Illinoian drift, numbered for reference to the text.

till are predominantly chert and include only a small proportion of limestone. The lower till also contains purple quartzite pebbles, which were not noted in the upper till at this place.

The interglacial horizon from the south end of the cut declines slightly and then rises northward 10 feet in 100 feet so that in the north part it is about midway between top and bottom of the bluff (fig. 3). It seems entirely possible that the position of this interglacial horizon is now the same as it was during the interval between the deposition of the first drift and that of the Illinoian till. This seems clear from the fact that even the turf of the old soil is preserved, doubtless due to the fact that it was on the lee side

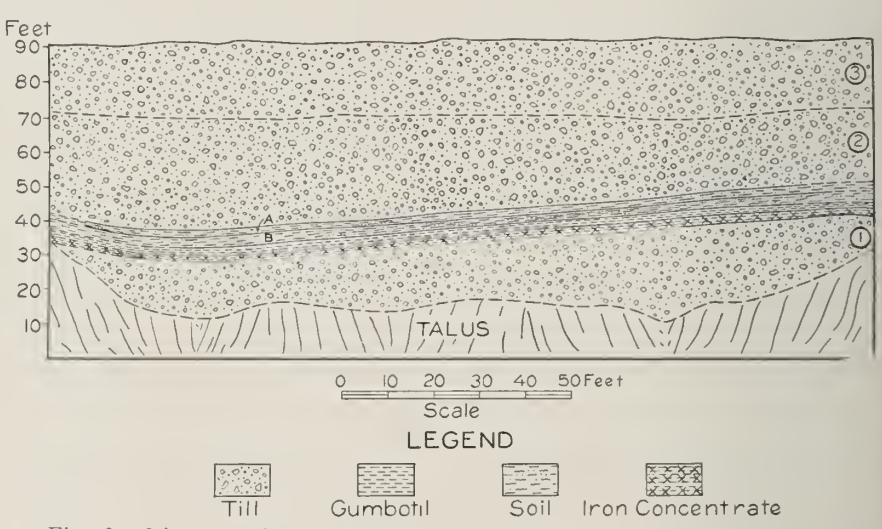

Fig. 3. Diagram of the Big Creek exposure showing calcareous, unoxidized, Nebraskan (?) till (1), overlain by interglacial deposits—iron concentrate, gumbotil, soils "B" and "A"—and by Illinoian till: calcareous, unoxidized (2); and calcareous, oxidized (3).

of a pre-Illinoian hill where there was no scouring by the Illinoian ice-sheet. The presence of perfect though fragile gastropod shells in the lower 6 or 8 feet of the Illinoian till suggests that the ground was frozen ahead of the oncoming ice and that the frozen fossil-bearing silt was moved and incorporated into the base of the Illinoian till. A thick deposit of this character is described below.

Pre-Illinoian drift in seventy-foot bluff along Big Creek.—A mile farther north along Big Creek (fig. 2, location 2) a 70-foot bluff undercut by the stream, making a steep, fresh exposure, reveals pre-Illinoian drift below Illinoian till in the following sequence:

Pleistocene deposits along Big Creek (South Center NE. ¼ sec. 34, T. 12 N., R. 12 W.)	Thickness *Feet*
Post-Illinoian	
7. Loess, weathered	4–6
Illinoian	
6. Sand and gravel, weathered	1½
5. Till, oxidized, leached	5±
4. Till, oxidized, calcareous	3
3. Till, blue-gray, calcareous	12
Pre-Illinoian	
2. Till, drab-buff to gray-green, oxidized, calcareous, very hard	12
1. Till, blue-gray, calcareous	30

The line of demarkation between the base of the blue-gray Illinoian till and the underlying oxidized till is very sharp and conspicuous. Evidently the soil and the leached part of the older drift were stripped away by the overriding Illinoian ice.

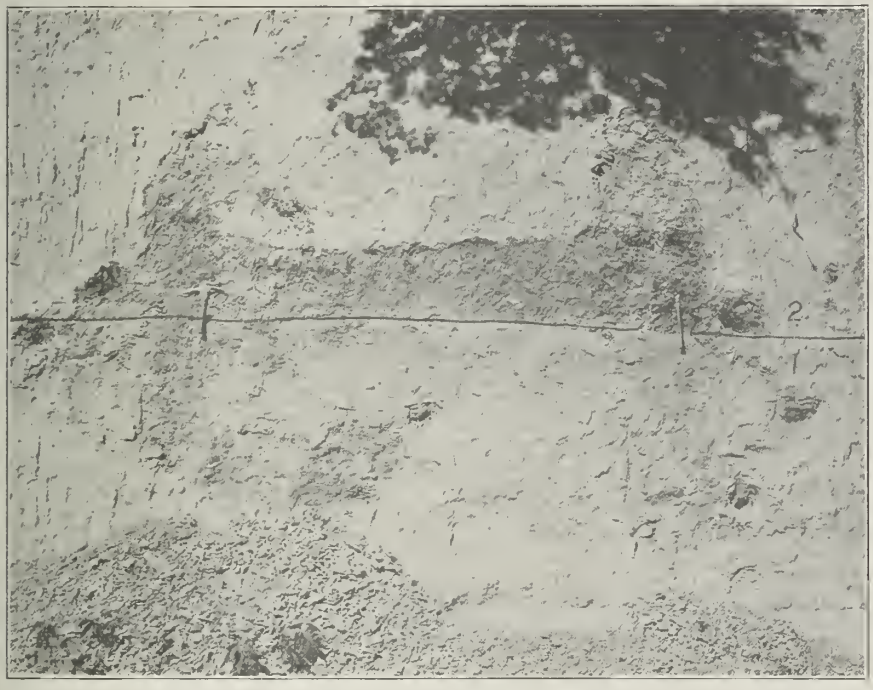

Fig. 4. Illinoian till (2) overlying pre-Illinoian till (1), half a mile north of Dennison, Clark County.

Pre-Illinoian drift along west branch of Big Creek.—Two miles still farther northwest, along the south side of the west branch of Big Creek (fig. 2, location 3) an exposure shows a great thickness of pre-Illinoian drift. The section measures:

Pleistocene deposits along west branch of Big Creek
(South Center NE. ¼ sec. 29, T. 12 N., R. 12 W.)

	Thickness *Feet*
Illinoian	
6. Till, oxidized and leached	8
5. Till, oxidized, calcareous	16
Pre-Illinoian	
4. Till, oxidized, leached, gummy	2
3. Till, oxidized, calcareous, hard	15
2. Till, blue-gray, calcareous	33
1. Bedrock	10

In this place the Illinoian ice did not erode away the weathered part of the lower till.

Pre-Illinoian drift near Dennison.—In the northeast corner of the county, half a mile north of Dennison (fig. 2, location 4) an exposure has been made by Clear Creek in undercutting its west bank just south of the road bridge. The bluff was very steep and the cut so fresh that there was no doubt that the relations were seen undisturbed (fig. 4). The following section was measured:

Pleistocene deposits along Clear Creek north of Dennison
(SW. ¼ NE. ¼ sec. 23, T. 12 N., R. 11 W.)

	Thickness *Feet*
Post-Illinoian	
8. Loess	4
Illinoian	
7. Till, oxidized and leached	4
6. Sand and gravel lenses	3
5. Till, oxidized, calcareous	4
4. Till, gravelly and sandy, calcareous, much indurated	3
3. Till, blue-gray, calcareous	8
Pre-Illinoian	
2. Till, red-brown, oxidized, leached	½–1½
1. Till, greenish-gray, drab, calcareous, very hard	11

The lower till is so compact that the sharp pick, when driven with full strength, penetrated it only about an inch. Among other features common to pre-Illinoian till of the region it contains many small purple quartzite pebbles.

Pre-Illinoian drift northeast of Marshall.—Another exposure is found five and a half miles east-northeast of Marshall, half a mile east of Weaver (fig. 2, location 5) on the west bluff of the valley just south of the highway bridge. Here the section shows:

Pleistocene deposits northeast of Marshall (SW. ¼ SW. ¼ sec. 1, T. 11 N., R. 11 W.)

	Thickness Feet
Post-Illinoian	
5. Loess, weathered	40
Illinoian	
4. Till, leached and oxidized	
3. Till, blue-gray, soft, calcareous	
Pre-Illinoian	
2. Sand and silt, oxidized, calcareous	1–3
1. Till, gray-green drab, darker along the joints, dense, hard, calcareous	15

The presence of the hard, oxidized till below soft and unoxidized drift shows that the lower one is pre-Illinoian in age and was oxidized before the Illinoian was deposited. The absence of the leached part of the lower till is accounted for by its having been stripped away by the Illinoian ice-sheet during its advance over this area.

Exposures of pre-Illinoian drift along Mill Creek southwest of Marshall.—The road-grade up the south valley-wall of Mill Creek, four and a half miles south-southwest of Marshall (fig. 2, location 6) has made an exposure about 65 feet high:

Pleistocene deposits along Mill Creek four and a half miles southwest of Marshall (NW. ¼ NE. ¼ sec 16, T. 10 N., R. 12 W.)

	Thickness Feet
Illinoian	
4. Silt, weathered, loesslike	5–8
3. Till, silty, pebbly, blue-gray, fossiliferous; leached 10 to 12 feet	40
Pre-Illinoian	
2. Till, sand, and silt, leached, oxidized; disturbed	10
1. Gravel, calcareous	3

The thick silt resembles loess in texture but contains many glacial stones scattered entirely through it. It is predominantly blue-gray in color but has been oxidized to brown along numerous intersecting joints, outward from which diffusion has banded the mass concentric with the joint-blocks. The material is highly fossiliferous. The following species were identified by Mr. F. C. Baker:

Fossils from Illinoian deposit along Mill Creek

1. Polygyra sp. Crushed
2. Polygyra monodon (Rackett)
3. Polygyra hirsuta (Say)
4. Hendersonia occulta (Say)

5. Succinia ovalis (Say)
6. Helicodiscus paralellus (Say)
7. Strobilops virgo (Pilsbry)
8. Galba parva (Lea)
9. Carychium exiguum (Say)
10. Pomatiopsis lapidaria (Say)
11. Pisidium sp.

Mr. Baker makes the following comments: "Numbers 1 to 7 are land shells. Numbers 8 to 10 inhabit fresh water but are mostly amphibious, spending much time on wet mud flats. Number 11 is a true fresh water shell, a small clam, requiring water for existence; possibly washed into the deposit from a near-by stream or pond"—or moved there by the Illinoian ice. The entire lack of stratification of the deposit and the presence of the glacial stones makes it evident that the fossils must have been picked up by the advancing Illinoian ice. Their age consequently must be either very early Illinoian or pre-Illinoian, probably the latter.

Four miles southwest of Marshall (fig. 2, location 7) the valley bluff for 100 yards reveals pre-Illinoian drift below Illinoian till and loess in the following section:

Pleistocene deposits along Mill Creek four miles southwest of Marshall (NE. ¼ NW. ¼ sec. 9, T. 10 N., R. 12 W.)

	Thickness *Feet*
Post-Illinoian	
8. Loess and silt	15–18
Illinoian	
7. Weathered till	2–3
6. Till, with incorporated silt and sand layer	20
Pre-Illinoian	
5. Gumbotil, brownish	3
4. Till, brown, hard, leached	3
3. Till, brown-gray-drab, hard, dense, calcareous	10
2. Sand and gravel, stratified, calcareous	20
1. Bedrock, Pennsylvanian	10

The sand and gravel appears to be outwash material deposited in front of the advancing edge of the pre-Illinoian glacier and then over-ridden and buried by the till of this same advance.

A mile farther north along the same valley-wall (fig. 2, location 8) the section also shows pre-Illinoian outwash and till, though here the soil layer of the lower till has been eroded away.

Pleistocene deposits along Mill Creek three miles southwest of Marshall (West Center NE. ¼ sec. 4, T. 10 N., R. 12 W.)

	Thickness *Feet*
Post-Illinoian	
7. Loess, weathered	6–8
Illinoian	
6. Soil zone, highly weathered	2½
5. Till, oxidized	3½
4. Till, bluish-gray	10
Pre-Illinoian	
3. Till, brownish-buff, very dense	1
2. Sand, coarse	8
1. Gravel, fine	10

It is possible that here waters circulating through the underlying sand and gravel formation altered the lower part of the blue-gray Illinoian till to make it look like an older drift-sheet, although no banding was seen in the altered till. However, the proximity and similarity of this exposure to the unmistakable pre-Illinoian drift described above gives confidence to its interpretation as pre-Illinoian drift.

Pre-Illinoian drift along west branch of Mill Creek.—On the west branch of Mill Creek, five and a half miles west-southwest of Marshall (fig. 2, location 9) the stream has undercut a bank 250 feet long and 35 to 40 feet high. The exposure shows typical pre-Illinoian drift below Illinoian in the following order:

Pleistocene deposits along west branch of Mill Creek (SE. ¼ SE. ¼ sec. 36, T. 11 N., R. 13 W.)

	Thickness *Feet*
Post-Illinoian	
9. Silt, loessial, and soil	6–10
8. Loess, gray, mottled brown	3
Illinoian	
7. Gumbotil	3
6. Till, weathered and leached	3
5. Till, brown, leached	1–1½
4. Till, brown, calcareous	5–8
3. Till, blue-gray, calcareous	5–10
Pre-Illinoian	
2. Till, brown, weathered, leached	1–2
1. Till, brown with greenish tinge; very dense and hard; calcareous	10

The line of contact between the two tills, though undulatory, is sharp and easily seen (fig. 5). Pebble counts from the two tills show considerable differences:

Pebble counts from Illinoian and pre-Illinoian tills

	ILLINOIAN TILL	PRE-ILLINOIAN TILL
	Per cent	*Per cent*
Chert	33	20.8
Limestone	21	52.8
Sandstone	10	10.4
Shale	5	...
Granite	5	.8
Basalt	10	5.6
Felsite	1	.8
Diorite	5	.8
Greenstone	0	.8
Quartzite (brownish)	9	...
Quartzite (purple)	...	14.8
Quartz	1	1.6

The greatest difference is in the larger number of limestone and quartzite pebbles in the lower till and of chert in the upper. This is the same difference which was noted in the Big Creek exposure (p. 31) where the pre-Illinoian drift contained 54 per cent of limestone and only 7 per cent of chert pebbles.

Another river-bluff section showing two tills is seen three and a half miles northwest of Marshall (fig. 2, location 10). The relationship of material shows below a slumped and wooded upper slope.

Pleistocene deposits three and a half miles northwest of Marshall (SE. ¼ NE. ¼ sec. 17, T. 11 N., R. 12 W.)

	Thickness *Feet*
Illinoian	
4. Till, blue-gray, calcareous	15
3. Clay, fatty, leached; fragments have "slickensided" collodial surfaces	½
Pre-Illinoian	
2. Sand, gravel and silt, oxidized, calcareous	10
1. Till, blue-gray, calcareous	3½

The presence of leached and weathered clay on the oxidized sands and gravels shows that the pre-Illinoian drift was weathered before the till was deposited.

EDGAR COUNTY

Pre-Illinoian drift along Clear Creek.—In Edgar County two miles north of the eastern part of Clark County (fig. 2, location 11), on the west bluff of Clear Creek, pre-Illinoian drift and weathered zone is shown in the following section:

Fig. 5. Illinoian till (2) overlying pre-Illinoian till (1) along west branch of Mill Creek, Clark County.

Glacial and interglacial deposits along Clear Creek (East Center NE. ¼ sec. 9, T. 12 N., R. 11 W.)

	Thickness *Feet*
Post-Illinoian	
7. Loess and silt	8–10
Illinoian	
6. Old soil zone	3
5. Till	25
Pre-Illinoian	
4. Silt, gummy, pebbly in places, leached and weathered	3
3. Till, leached	3
2. Sand and gravel, calcareous	2
1. Till, calcareous	8

In this exposure the over-riding ice must have eroded very little.

COLES COUNTY

Pre-Illinoian drift along Hurricane Creek.—In Coles County, three miles west of the northwestern part of Clark County (fig. 2, location 12) the west bluff of Hurricane Creek drops almost vertically from the flat, tabular upland. Along this fresh exposure, which is 45 feet high and 500 feet long, the following sections were measured:

Pleistocene deposits along Hurricane Creek (NW. ¼ SE. ¼ sec. 22, T. 11 N., R. 10 E.)

A—SECTION AT NORTH END OF EXPOSURE

	Thickness *Feet*
Post-Illinoian	
5. Loess-like silt	5–7
Illinoian	
4. Till, leached	3–5
3. Till, calcareous	8–10
Pre-Illinoian	
2. Till and silt, leached and weathered; containing much preserved vegetation	1–3
1. Till, calcareous	15

B—SECTION IN SOUTH PART OF EXPOSURE

3. Loess-like silt, leached	9
2. Till, leached	8
1. Till, calcareous; wood incorporated in zone through the middle	30

In the south part of the cut the Illinoian ice evidently eroded away the interglacial material, but the abundance of woody matter above a certain

zone suggests that this zone and all till above is Illinoian and that the wood is from interglacial vegetation.

CUMBERLAND COUNTY

Pre-Illinoian drift northeast of Toledo.—Cumberland County adjoins Clark County on the west (fig. 1). Its topography consists of tabular divides left by the erosion of a remarkably flat till-plain. An exposure along one of the valleys in the northeast part of the county six miles northeast of Toledo (fig. 1, location 13) reveals pre-Illinoian till below Illinoian in the following measured section:

Pleistocene deposits northeast of Toledo (Center NE. ¼ sec. 10, T. 10 N., R. 9 E.)

		Thickness *Feet*
Illinoian		
6.	Top concealed	
5.	Till, blue-gray at base, calcareous	15-18
Pre-Illinoian		
4.	Clay, leached, oxidized, gummy, yellow	½
3.	Till, leached and oxidized	½
2.	Till, oxidized, calcareous	6
1.	Till, unoxidized, calcareous	15

How much deeper the pre-Illinoian till extends is unknown for no well records were available.

EFFINGHAM COUNTY

Pre-Illinoian drift near Effingham.—Effingham County in turn borders Cumberland on the west and lies just east of the center of the State. It likewise shows remarkably flat tabular-divide topography trenched by steep-sided valleys. A small valley three miles northeast of Effingham (fig. 1, location 14) shows pre-Illinoian till in a well exposed section:

Pleistocene deposits northeast of Effingham (SE. ¼ sec. 11, T. 8 N., R. 6 E.)

		Thickness *Feet*
Illinoian		
4.	Till, calcareous, blue-gray in lower 6 feet	18–20
Pre-Illinoian		
3.	Till, oxidized, leached	1
2.	Till, oxidized, calcareous	9
1.	Till, unoxidized, calcareous	5–8

From the contact between the two tills and extending downward into the lower drift for a foot or more there are pockets of gray gumbotil-like material, leached and sticky. This strongly suggests that gumbotil had formed on the pre-Illinoian drift with these stringers penetrating the underlying drift, and that the main body of gumbotil was removed by the Illinoian glacier.

Pre-Illinoian drift near Altamont.—A second exposure of pre-Illinoian drift in Effingham County is seen in the valley two miles south of Altamont (fig. 1, location 15). The south wall of the valley is here a perpendicular bluff of drift more than 250 feet in length. The section as measured shows:

Pleistocene deposits south of Altamont
(SW. ¼ sec. 22 T. 7 N., R. 4 E.)

	Thickness *Feet*
Illinoian	
4. Till, calcareous; lower 20 feet unoxidized	35
Pre-Illinoian	
3. Silt, leached, oxidized	0–1
2. Gumbo, leached, yellow	0–3
1. Till, calcareous, dense, hard	0–12

The contact between the two tills dips gently westward and below stream-level, which accounts for the variation in thickness of the lower drift. There are some masses of the weathered lower drift in the basal part of the overlying Illinoian till.

A buried soil zone near Effingham.—A third exposure of the older drift where the buried soil is well preserved is seen one mile northeast of Effingham (fig. 17, location 16):

Pleistocene deposits near Effingham
(NE. ¼ sec. 21, T. 8 N., R. 6 E.)

	Thickness *Feet*
Illinoian	
2. Till, calcareous; lower 10 feet unoxidized; containing gravel lenses and much wood in the lower part	30
Pre-Illinoian	
1. Soil, leached	
A. Light fluffy silt	1½
B. Heavy, dense, gray-brown silt containing scattered erratic pebbles	3

FAYETTE COUNTY

Fayette County lies west of Effingham County and in the mid-line of the State. It is traversed from northeast to southwest by Kaskaskia River, to the east of which tabular-divide topography predominates, rising here and there to a low hill of constructional topography, whereas to the west of the Kaskaskia subdued and eroded hills of morainic origin prevail. Within the county six exposures of pre-Illinoian till have been found; two in the eastern part, one in the center, and three in the northwestern part.

Pre-Illinoian drift near Louden.—On Sugar Creek one mile southwest of Louden (fig. 1, location 17) the road-side bank exposes the material of the hill through a thickness of over 80 feet:

Pleistocene deposits near Louden (South Center sec. 1, T. 7 N., R 2 E.)

	Thickness *Feet*
Illinoian	
2. Till, blue-gray; slightly oxidized along cracks; normal hardness; calcareous	60
Pre-Illinoian	
1. Till, buff-brown to gray, yellow-orange; hard, dense; calcareous	20

The line of contact between the two tills dips about 20° to the east so that at the west end of the cut the lower drift is much thicker than at the east end. The leached and weathered part of the lower till was eroded away by the Illinoian ice, leaving only the oxidized portion to reveal the presence of the two drift-sheets.

Pre-Illinoian drift along Hickory Creek.—Halfway between Brownstown and Confidence on the south side of Hickory Creek (fig. 1, location 18) ditches on both sides of the road show:

Glacial and interglacial deposits near Hickory Creek (South Center sec. 24, T. 6 N., R. 2 E.)

	Thickness *Feet*
Illinoian	
3. Gumbotil	3
2. Till, calcareous, buff	4
Pre-Illinoian	
1. Silt, leached, hard, dense; scattered siliceous pebbles and wad pellets, black material	4–5
Base concealed	

The lower material is doubtless a pre-Illinoian soil. It may be either on bedrock or pre-Illinoian drift, but from its texture, appearance, and pebble content it is probably the latter.

Pre-Illinoian drift at Vandalia.—At the highway bridge-head on the eastern outskirts of Vandalia, Kaskaskia River has so undercut its west bank as to expose a bluff of drift about 70 feet high and 300 feet long (fig. 1, location 19; fig. 6). The succession of materials is:

Pleistocene deposits at bridge in East Vandalia

	Thickness *Feet*
Post-Illinoian	
6. Loess, weathered	10
Illinoian	
5. Sand and gravel, weathered to reddish-brown	10
4. Till, leached	3
3. Till, calcareous	35
Pre-Illinoian	
2. Till, leached, oxidized	1½+
1. Till, calcareous, mostly oxidized	8

The leached upper part of the pre-Illinoian till is somewhat irregular along the cut due to the disturbing action of the over-riding Illinoian ice. Along the irregular joints of the lower till there has been some deoxidation, leaving them drab in color, although the remainder of the till is buff to brownish. This lower till is visible only at time of low water in Kaskaskia River.

Pre-Illinoian gumbotil south of Ramsey.—Two miles south of Ramsey in a deep valley tributary to Boaz Creek (fig. 1, location 20; east center sec. 30, T. 8 N., R. 1 E.) the road-cut shows 60 feet of Illinoian till containing several lenses and pockets of sand and gravel, resting on four feet of gray-blue, plastic, sticky gumbotil of pre-Illinoian age. This gumbotil is completely "gumboized," making it a homogeneous mass in color and texture.

Exposures of buried soil-profile near Ramsey.—One and a half miles northeast of Ramsey (fig. 1, location 21) the highway-cut on the north side of a small valley trenching a wide flat, shows the following section:

Glacial and interglacial deposits one and a half miles northeast of Ramsey (Center sec. 4, T. 8 N., R. 1 E.)

	Thickness *Feet*
Illinoian	
6. Soil zones	6½
5. Gumbotil and Ferretto zone	4
4. Till, leached, heavily stained with iron	1
3. Till, calcareous, oxidized	15
Pre-Illinoian	
2. Silt, pebbly, dark (gumbotil A)	2–3
1. Gumbotil, dark bluish-gray, very sticky (gumbotil B)	4
From road-level to bottom of valley	18

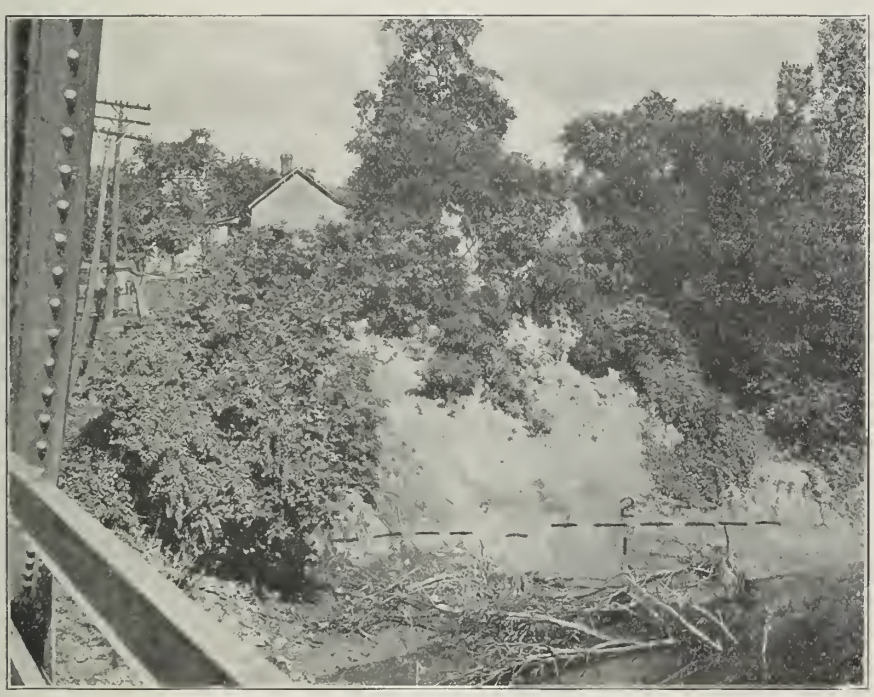

Fig. 6. The west bluff of Kaskaskia River valley at Vandalia, Fayette County, showing Illinoian till (2) overlying pre-Illinoian till (1).

Half a mile east down the small valley (fig. 1, location 22) the stream has undercut its south valley-wall to make a bluff which shows:

Glacial and interglacial deposits near Ramsey
(SE. ¼ sec. 4, T. 8 N., R. 1 E.)

		Thickness *Feet*
Illinoian		
7.	Soil and Ferretto zones	6–7
6.	Till, oxidized, calcareous	10
5.	Till, unoxidized, calcareous	15
Pre-Illinoian		
4.	Silt, blue-gray, leached (gumbotil A)	1–2½
3.	Gumbotil, blue-gray, buff-brown at the bottom (gumbotil B)	3½
2.	Till, leached, oxidized	3½
1.	Till, calcareous, oxidized, hard; some silt and sand pockets	6
	Stream-level	

These two exposures are remarkable in that the Illinoian ice failed to erode away the upper, or A horizon, of the pre-Illinoian gumbotil soil-profile. And furthermore, it is interesting to find the humus still present in the upper part of this buried soil-profile.

SHELBY COUNTY

Pre-Illinoian till and gumbotil along Opossum Creek.—A deep highway-cut on the west side of Opossum Creek (fig. 1, location 23) where the river has cut a deep valley below the general upland till-plain, shows the following succession of pre-Illinoian and Illinoian drifts (fig. 7):

Pleistocene deposits along Opossum Creek (North Center sec. 21, T. 10 N., R. 1 E.)

		Thickness *Feet*
Illinoian		
5.	Soil zones and leached till	14
4.	Till, calcareous, oxidized	12–14
Pre-Illinoian		
3.	Gumbotil, dark blue-gray, plastic and sticky, typical in every respect—top slightly undulatory due to over-riding by the Illinoian ice	3
2.	Till, leached, oxidized	1
1.	Till, calcareous, oxidized (contains lense-like mass of fossiliferous silt—2 feet)	8
	Road level—but till is seen to bottom of the valley	20

LEGEND

4. Silts, soil and loess
3. Illinoian till, leached, oxidized
2. Illinoian till, calcareous, oxidized
1. Pre-Illinoian gumbotil

Fig. 7. Exposure of Pleistocene deposits two miles northeast of Oconee, Shelby County, west bluff of Opossum Creek.

MONTGOMERY COUNTY

Pre-Illinoian drift near Hillsboro.—One of the most spectacular exposures of pre-Illinoian drift in the State is one and a half miles northwest of Hillsboro (fig. 1, location 24, south center sec. 34, T. 9 N., R. 4 W.). Here the state highway rises about 100 feet from the broad flat to the west to the crest of a conspicuous group of hills trending north and south. From the crest a fine view is obtained across the flat to Litchfield seven miles away. Through the crest of this hill a highway-cut 30 feet deep exposes an interesting Pleistocene succession (fig. 8).

Till, having a normal soil-profile down to calcareous drift, is seen on either flank of the hill. At the crest of the hill and dipping 30° eastward across the face of the cut is a layer of pebbly sand. This layer is 6± feet thick, made of coarse sand stained yellow to orange and to brownish near its base. At the top the sand layer grades imperceptibly into a layer of very dark gray, sticky, slick, heavy clay, 6 to 7 feet thick, containing a few siliceous pebbles. It is evidently a gumbosand produced by the weathering of the pebbly sand below (fig. 9). It is evident that the gumbosand is pre-Illinoian in age and was picked up, doubtless while in a frozen condition, and pushed into this peculiar position in the morainic hill by the Illinoian ice-sheet. It is not evident whether the till below the sand and gumbosand layer is of Illinoian or pre-Illinoian age, though from the relations the latter seems to be the more probable as a tentative hypothesis.

Pre-Illinoian drift northeast of Litchfield.—Descriptions of several other exposures of pre-Illinoian drift in the county have been published.[2] A good exposure occurs in a ravine northeast of Litchfield (fig. 1, location 25) where Dr. Lee measured the following section:

Glacial and interglacial deposits northeast of Litchfield
(NW. ¼ sec. 35, T. 9 N., R. 5 W.)

	Thickness	
	Feet	*Inches*
Illinoian glacial		
5. Till, dense, gray, covered in wooded slopes	—	
Yarmouth (?) interglacial		
4 Sand, blue-gray, calcareous	4	
3. Loam, blue-gray, carbonaceous, fossiliferous		2–14
2. Sand, irregularly laminated, weathered brown; shells in upper part	2	
Kansan (?) glacial		
1. Till, dense, calcareous, weathered; rusty zones around cracks	—	

See classification of Pleistocene time, page 27, for relationship of glacial and interglacial epochs named.

2 Lee, Wallace, U. S. Geol. Survey Geol. Atlas Gillespie-Mount Olive Folio (No. 220), pp. 6-7, 1926.

Fig. 8. An exposure showing tilted bands of gumbosand (A) and sand (B) in the morainic hill above the Litchfield flat, two miles northwest of Hillsboro, Montgomery County (see Fig. 9).

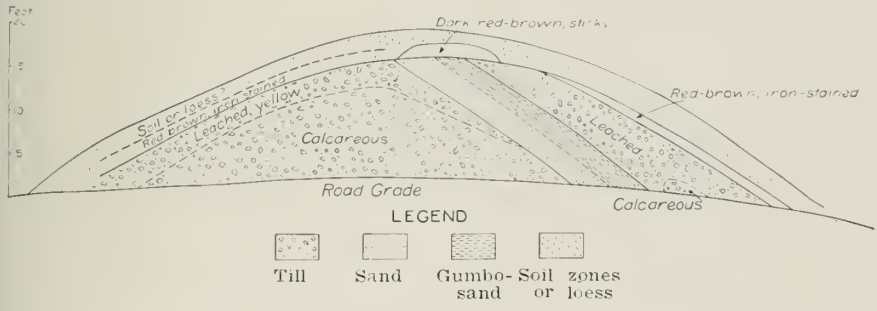

Fig. 9. Diagram of exposure in a road-cut on a morainic hill near Hillsboro (see Fig. 8).

A second pre-Illinoian section described by Dr. Lee (fig. 1, location 26) shows:

Glacial and interglacial deposits four miles east of Litchfield (SW. ¼ NW. ¼ sec. 32, T. 9 N., R. 4 W.)

	Thickness Feet	Inches
Illinoian glacial		
6. Till, oxidized	5	
5. Till, fresh	15	
4. Till, carbonaceous	1	
Yarmouth (?) interglacial		
3. Soil line, calcareous		1
2. Sand, fine, with pebbles, calcareous		3–5
Kansan (?) glacial		
1. Till, fine, sandy, and pebbly; calcareous	4	
Limestone	—	

And southeast of Hillsboro (fig. 1, location 27) Dr. Lee discovered interglacial alluvial deposits described in the following section:

Glacial and interglacial deposits southwest of Hillsboro (NW. Corner sec. 16, T. 8 N., R. 4 W.)

	Thickness Feet
Illinoian glacial	
6. Till, oxidized, red, very sandy and pebbly, with subordinate clay	40
Yarmouth (?) interglacial	
5. Sand, black, gravelly	4
4. Sand and gravel, like river gravel	8
3. Sand, fine, calcareous, fossiliferous	1+
2. Talus	9
Kansan (?) glacial	
1. Till	6+

MACOUPIN COUNTY

Pre-Illinoian drift near Staunton.—In a ravine one mile north of Staunton (fig. 1, location 28) the section[3] shows:

Glacial and interglacial deposits north of Staunton (SW. ¼ sec. 20, T. 7 N., R. 6 W.)

	Thickness Feet	Inches
Illinoian glacial		
8. Till, buff to bluish-gray	40	
Yarmouth (?) interglacial		
7. Sand or sandy clay	2	
6. Clay, bluish, tough, with small stems		2

[3] Lee, Wallace, op. cit.

5.	Sand, yellowish	0–6
4.	Sandy loam, black and carbonaceous, grading downward into sand; fossiliferous	6–12
3.	Sand, reddish-brown	2–3
Kansan (?) glacial		
2.	Till, weathered	1
1.	Till (estimated thickness)	30

GREENE COUNTY

Pre-Illinoian drift near Carrollton.—Four miles south of Carrollton (fig. 1, location 29) the stream in undercutting the west valley-wall has exposed the following measured section (fig. 10).

Glacial deposits south of Carrollton (NW. ¼ NW. ¼ sec. 11, T. 9 N., R. 12 W.)

		Thickness *Feet*
Illinoian		
3.	Till, oxidized	25
2.	Till, unoxidized, calcareous; contains much wood incorporated in the lower foot	15
Pre-Illinoian		
1.	Till, oxidized, calcareous, hard; many vertical joints more oxidized than the rest of the deposits	18

The fact that the lower till is oxidized, whereas the lower 15 feet of the upper till is not oxidized, seems conclusive evidence that the former is an older drift sheet which was weathered before Illinoian time. If this is correct the Illinoian ice must have eroded the leached part of the lower till, a thickness of at least 10 to 15 feet.

MORGAN COUNTY

Pre-Illinoian deposits along a tributary to Coal Creek.—A road-cut up the west side of a tributary to Coal Creek (fig. 1, location 30) shows pre-Illinoian drift in the following section:

Glacial and interglacial deposits along a tributary to Coal Creek (East Center sec. 35, T. 13 N., R. 11 W.)

		Thickness *Feet*
Post-Illinoian		
6.	Loess, leached	8
Illinoian		
5.	Till, leached, oxidized	8
4.	Till, calcareous	12

Pre-Illinoian		
Interglacial		
3.	Loess, calcareous, fossiliferous	5
2.	Silt, leached, chocolate-brown	8
Glacial		
1.	Till, leached, very clayey; containing erratic pebbles	10

The lower till is dark in color, dense, and made mostly of clay containing erratic pebbles of quartzite, greenstone, and granite in considerable abundance. It looks quite different from the Illinoian till. The chocolate-brown leached silt seems to be the same as that found below the Illinoian till at many widely scattered places in southern Illinois. The calcareous and fossiliferous loess below Illinoian till has been found only in the west part of the area near Illinois River.

SCOTT COUNTY

Interglacial deposit along Little Sandy Creek.—At the south margin of the county (fig. 1, location 31) Little Sandy Creek in swinging against its north bank has exposed a fine section of pre-Illinoian drift (fig. 11):

Glacial and interglacial deposits along Little Sandy Creek (SW. ¼ NE. ¼ sec. 32, T. 13 N., R. 12 W.)

		Thickness *Feet*
Illinoian glacial		
7.	Till, calcareous; including masses of calcareous loess and leached brown silt in lower 6 feet	15
Pre-Illinoian		
Interglacial		
6.	Loess, buff, calcareous, fossiliferous	½
5.	Loess, drab, calcareous	2½
4.	Silt, leached, dense, chocolate-brown	3
3.	Silt, calcareous, drab, few scattered pebbles	1
Glacial		
2.	Till, greenish-black, dense, clayey; leached, but with spots of secondary lime	3
1.	Till, greenish-black, dense, clayey, slightly calcareous	4

The lower till looks entirely unlike the Illinoian in that it is very dark in color with little gray splotches the size of a pea scattered through the mass. Pebbles also are much less numerous but include many kinds of erratics so that the deposit must be of glacial origin.

Pre-Illinoian drift north of Manchester.—Another section showing the same Pleistocene succession is seen in the southeast part of the county one and a half miles north of Manchester (fig. 1, location 32). Here a deep road-cut down the south valley wall shows:

Fig. 10. An exposure showing Illinoian till (2) overlying pre-Illinoian till (1), four miles south of Carrollton, Greene County

LEGEND

4. Illinoian till
3. Interglacial loess, calcareous, fossiliferous
2. Interglacial silt
1. Pre-Illinoian till

Fig. 11. Exposure of Pleistocene deposits in southern Scott County (SW. ¼ NE. ¼ sec. 32, T. 13 N., R. 12 W.)

Glacial and interglacial deposits north of Manchester
(South Center SE. ¼ sec. 16, T. 13 N., R. 11 W.)

	Thickness *Feet*
Peorian interglacial	
9. Loess, buff-colored	5–7
Late Sangamon interglacial	
8. Loess, brown	2–3
Illinoian glacial	
7. Till, calcareous; weathered to well-drained profile	25
Pre-Illinoian	
Interglacial	
6. Loess, calcareous, fossiliferous	3½
5. Silt, leached, chocolate-brown	6
Glacial	
4. Concealed part of section	6–8
3. Till, weathered, gummy, buff-colored	2
2. Till, leached	5
1. Till, calcareous	20

Pre-Illinoian gumbotil along Mauvaise Terre Creek.—One additional section in Scott County might be mentioned. It is along a road-cut down the steep southern wall of the valley of Mauvaise Terre Creek in the north central part of the county (fig. 1, location 33):

Pleistocene deposits along Mauvaise Terre Creek
(West Center SE. ¼ sec. 21, T. 15 N., R. 12 W.)

	Thickness *Feet*
Illinoian	
4. Till, calcareous	25–30
Pre-Illinoian	
3. Gumbotil, gray, sticky, leached	3
2. Till, leached	5
1. Till, calcareous	25–30

The exposure is none too good for accurate measurements, but the members of the succession seem fairly clear.

RANDOLPH COUNTY

Glacial and interglacial deposits near Sparta.—In the southwestern part of the State one exposure of pre-Illinoian till has been located southwest of Sparta (fig. 1, location 34) where the older till is separated from the overlying Illinoian by a 12-foot bed of leached, dense silt.[4]

[4] MacClintock, Paul, Pre-Illinoian till in southern Illinois: Journal of Geology, vol. 34, p. 175, 1926.

Generalized section of Pleistocene deposits near Sparta

	Thickness *Feet*
Post-Illinoian	
7. Loess	3–5
Illinoian	
7. Gumbotil	2
5. Till, leached	13
Pre-Illinoian	
Interglacial	
4. Loess, leached	15
Glacial	
3. Gumbotil	3
2. Till, leached	6
1. Till, calcareous	5½

AGE OF THE PRE-ILLINOIAN DRIFT

The problem of the age of the pre-Illinoian glacial deposits is still open—they may be either Kansan or Nebraskan or both. It seems fairly clear that the Kansan ice-sheet crossed Mississippi River into the west part of the State—probably as far as Illinois River. It likewise seems evident that the older drift in the eastern and central part of the state was deposited by an ice-sheet radiating from the Labradorean center, probably over much the same route which the Illinoian ice subsequently followed. Within the area studied by the writer no exposure has been found showing more than one pre-Illinoian till, and consequently there is no direct evidence as to its age. Mr. Leverett[5] thinks that the old drift found in Missouri, judging from the amount of decay and erosion, is of Nebraskan age, which suggests that the lower till in Randolph County is also Nebraskan (see above). It would logically follow, though not necessarily, that the older drift in the eastern and central parts of the State, which must have been covered by the ice-sheet that reached Randolph County, is also of Nebraskan age.

A most interesting exposure in this connection has been found by Dr. Wanless[6] in Fulton County just west of Illinois River, where a cut bank on the north wall of a ravine shows the following section:

Glacial and interglacial deposits in Fulton County
(SW. Corner NE. ¼ NE. ¼ sec. 5, T. 3 N., R. 3 E.)

	Thickness *Feet*
Illinoian glacial	
6. Slump	3–4
5. Till, calcareous, gray	12½

[5] Personal communication.
[6] Personal communication.

Yarmouth interglacial

4. Silt, calcareous, bluish-gray; weathered surface, dark chocolate-brown; disturbed, fossiliferous 6
3. Rusty, calcareous zone ..... ½

Kansan glacial

2. Till, calcareous, gray 3¼

Nebraskan glacial

1. A rolled ball of brown, oxidized, but calcareous till, 3 to 6 feet in diameter, occurs in eastern part of cut..... —

At the east end of the cut the lower surface of the Kansan till rises, exposing below it two feet of yellow, brown, calcareous sand (Aftonian?). About 200 yards downstream similar sands are underlain by brownish calcareous till that is probably Nebraskan in age. The presence of oxidized till below unoxidized till is interpreted as evidence that the lower is an older drift sheet which was oxidized before the overlying fresh till was deposited on it.

The significance of this sequence is at once obvious; it means that both Kansan and the Nebraskan drift sheets are present in this part of the State. It may well be that the Nebraskan is part of a Labradorean drift-sheet, that the pre-Illinoian drift in the central and eastern part of the State is Nebraskan, as suggested above, and that the Kansan is part of a Keewatin drift-sheet having connections to the northwest. But both the pre-Illinoian drift-sheets in Fulton County may be of Keewatin derivation, in which event the age of the eastward older drift is still uncertain. The former suggestion seems the more plausible though further study of more exposures will be required to settle the point.

EXTENT OF THE PRE-ILLINOIAN DRIFT

Known exposures of pre-Illinoian drift are scattered over a considerable portion of the southern part of the State, but as much of the area has been studied only in reconnaissance, other evidence of the extent of the older drift-sheet is desirable. It is a striking fact that pre-Illinoian drift has been found only within the area where the topography is controlled by drift and not in the marginal areas where the relief of the bedrock is the controlling factor in the topography (fig. 1). Well-records and bedrock outcrops indicate that the relief of the bedrock surface is virtually the same in the two types of topography. The suggestion naturally follows that probably the older drift so filled and aggraded the lower parts of the bedrock topography that the Illinoian ice transgressed a comparatively level surface within the area of the older drift and therefore deposited drift to control the present surface topography. Beyond the older drift the Illinoian till was not thick enough to dominate and control the topography. On this basis the pre-Illinoian drift-sheet may be extended somewhat beyond the

known exposures to include the area of topography controlled by drift (fig. 1).

HISTORICAL INTERPRETATION

In summary the Pleistocene history of the area, as far as it is now known, may be recorded.

(1) The pre-Illinoian glacier deposited a mantle of drift over the area bounded on the southeast by Clark, Jasper, Clay, Marion, Washington and Randolph counties, whereas on the west the area extends to the border of the state and is connected with the older drift area of Iowa.

(2) This drift-sheet was then exposed to weathering long enough for gumbotil to form on its surface, where the topography was flat enough for this type of soil-profile to develop.

(3) Stream erosion then cut into the surface, partly dissecting the drift and the gumbotil plains.

(4) Silt and much loess was then deposited over the area, in thickness from a few up to 15 feet. Whether this is Aftonian or Yarmouth in age still remains to be determined.

(5) The silt was then weathered and leached of its calcareous material to produce the chocolate-brown leached silt so common below Illinoian till.

(6) A second period of loess deposition spread calcareous and in places fossiliferous loess over the leached silts.

(7) Then followed the invasion of the Illinoian ice-sheet to its maximum extent.

(8) The ice retreated, with some local fluctuations, from the western part of the State to a position in the Kaskaskia River basin, where the ridged drift of that part of the area was deposited.

(9) The Illinoian ice-sheet was entirely melted away.

(10) Then followed weathering of the Illinoian till-sheet to mature soil-profiles, including the gumbotil in the poorly drained areas. Erosion by running water during this period of weathering evidently cut into the margins and finally into the interiors of the till-plain.

(11) Deposition of loess followed in late Sangamon time.

(12) The late Sangamon loess was weathered and leached, and in many places a recognizable soil-profile was developed in its upper part.

(13) The Peorian loess was deposited.

(14) The Peorian loess was weathered.

(15) Wisconsin outwash material was deposited along the drainage lines heading in the area of Wisconsin glaciation, contemporaneous slack-water aggradation occurred in tributaries to these drift-laden streams, and Wisconsin loess was deposited on the adjacent uplands.

(16) Post-glacial weathering and erosion has continued to the present time.